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January 17, 2003

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Project: RAC Region VIII, Contract No. 68-W5-0022
Work Assignment No. 902-RSBD-0822

DCN: 3282-902-CO-EFOU-16652

Subject: Evaluation of Metal Concentrations and Hardness-Based Standards when Mixing a Point Source Discharge with a Receiving Stream

Dear Ron:

As you know, the Priority Soils RI/FS group members have had many discussions concerning how to evaluate the performance of the Lower Area One Treatment Lagoons at different levels of hardness. The attached discussion and graphs demonstrate the results of mixing a receiving stream with a low hardness (such as Blacktail Creek) with discharge water from a treatment facility (with a high hardness). The range of possible mixtures are shown, and demonstrate that the two waters can be mixed in any proportion, and the resulting mixture will meet water quality standards, as long as both the receiving stream and the effluent are individually meeting standards.

Anyone who wishes to receive the spreadsheet with the mixing calculations can email me at frandsenak@cdm.com. If you have any questions concerning the attached discussion, please do not hesitate to call me.

Sincerely,

Angela Frandsen

Angela Frandsen
Environmental Engineer
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Evaluation of Metal Concentrations and Hardness-Based Standards when Mixing a Point Source Discharge with a Receiving Stream
Prepared by CDM, January 2003

The following discussion and attached graphs demonstrate that Blacktail Creek water and the discharge water from the Lower Area One treatment lagoons can be mixed in any proportion, and the resulting mixture will meet water quality standards, as long as both Blacktail Creek and the effluent are individually in compliance with WQB-7 standards.

Blacktail Creek water and treatment lagoon discharge water from station CTEFS6 were mixed in theoretical proportions that covered the entire range from 100 percent Blacktail Creek water (0 percent CTEFS6 water) to 100 percent CTEFS6 discharge water (0 percent Blacktail Creek water). Any mixture of the two waters would fall into this range. Concentrations in Blacktail Creek were initially set at the average concentrations calculated from the LAO Phase II monitoring report data (ESA Consultants, 2000).

Two different scenarios are presented. The first scenario assumes that Blacktail Creek concentrations are at the existing average concentrations. For simplicity, only copper concentrations were tabulated and graphed; however, any of the metals with hardness-based water quality standards could have been shown. The copper concentration was set at 9.6 µg/L and the hardness was set at 146 mg/L, the averages of the data presented in the LAO Phase II quarterly monitoring reports, August 1998 through May 2000 (ESA Consultants, 2000). The CTEFS6 concentrations were set at the maximum permissible concentrations (worst-case scenario) at 400 mg/L hardness. This is presented as Scenario 1 in the attached tables and graphs. Both the table and the graph show the resulting copper and hardness concentrations of the mixture, and then the calculated hardness-based standard. As the graph shows, the mixed copper concentration gradually approaches the hardness-based standard, but does not exceed the standard.

The second scenario assumes that the copper concentration in Blacktail Creek was at the maximum permissible concentration (12.89 µg/L) at the average hardness of 146 mg/L. This would be the worst-case scenario for Blacktail Creek without exceeding standards. As the second table and graph show, the resulting mixed copper concentration is right at the calculated hardness-based standard, but does not exceed it.

The attached tables and graphs demonstrate that as long as the effluent meets water quality standards calculated at the hardness measured in the effluent, and it is discharged into a receiving stream that also meets water quality standards, the resulting mixture will meet water quality standards.

Reference

ESA Consultants. 2000. Draft Lower Area One Expedited Response Action Final Phase II Monitoring Report For May 1998 Through June 30, 2000. September.

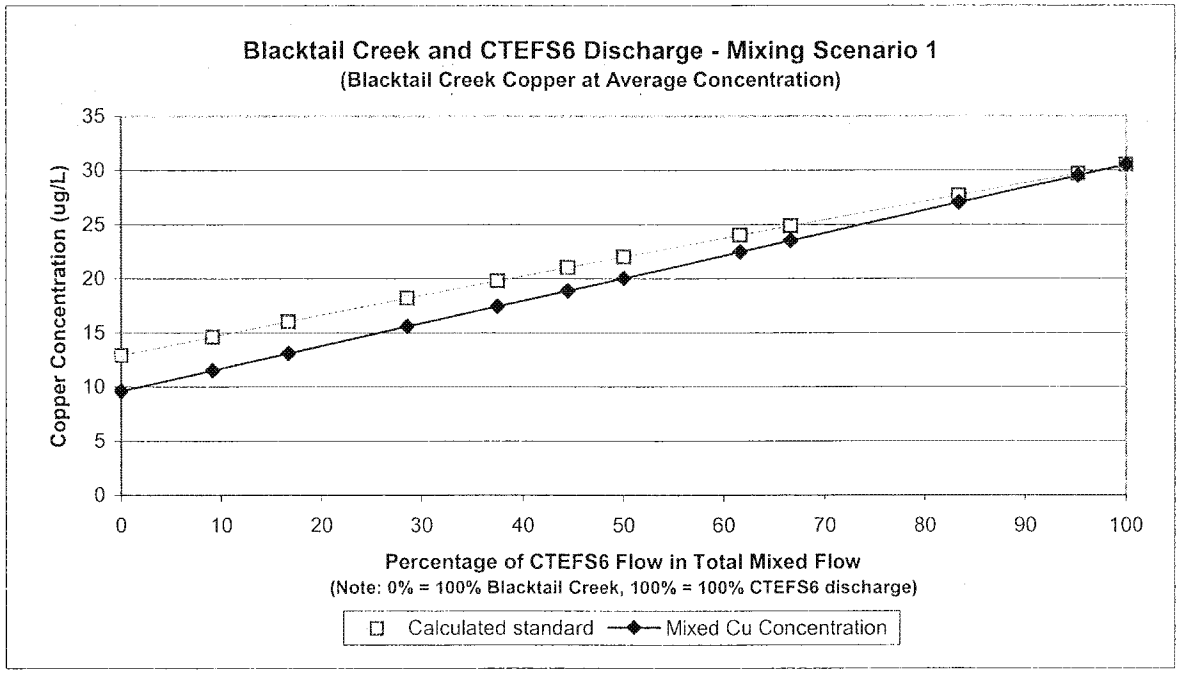
Scenario 1 - Blacktail Creek at near average concentrations

CTEFS6 hardness and concentrations at maximum
No other inputs (remove MSD, MPTP, STP etc.)

Parameters:

Blacktail: Cu = 9.6 ug/L, hardness = 146 mg/L, Cu standard = 12.13 ug/L
CTEFS6: Flow varies, Cu = 30.5 ug/L, hardness = 400 mg/L, standard = 30.5 ug/L

Blacktail flow (cfs)	CTEFS6 flow (cfs)	CTEFS6 % of total flow	Combined Cu (ug/L)	Combined Hardness (mg/L)	Calculated Cu Standard (ug/L)
5	0	0	9.6	146	12.89
5	0.5	9.1	11.5	169.09	14.61
5	1	16.7	13.08	188.33	16.02
5	2	28.6	15.57	218.6	18.2
5	3	37.5	17.44	241.25	19.8
5	4	44.4	18.89	258.9	21.03
5	5	50.0	20.05	219.9	22.01
5	8	61.5	22.46	302.3	24.01
5	10	66.7	23.53	315.33	24.89
2	10	83.3	27.02	357.67	27.72
0.5	10	95.2	29.5	387.9	29.71
0	10	100	30.5	400	30.5



Blacktail Creek concentrations averaged from Draft Lower Area One Expedited Response Action Final Phase II Monitoring Report For May 1998 Through June 30, 2000 (ESA Consultants, September 2000).

SBC mixing2 Scen 1

Scenario 2 - Blacktail Creek concentrations at WQB-7 standards

CTEFS6 hardness and concentrations at maximum

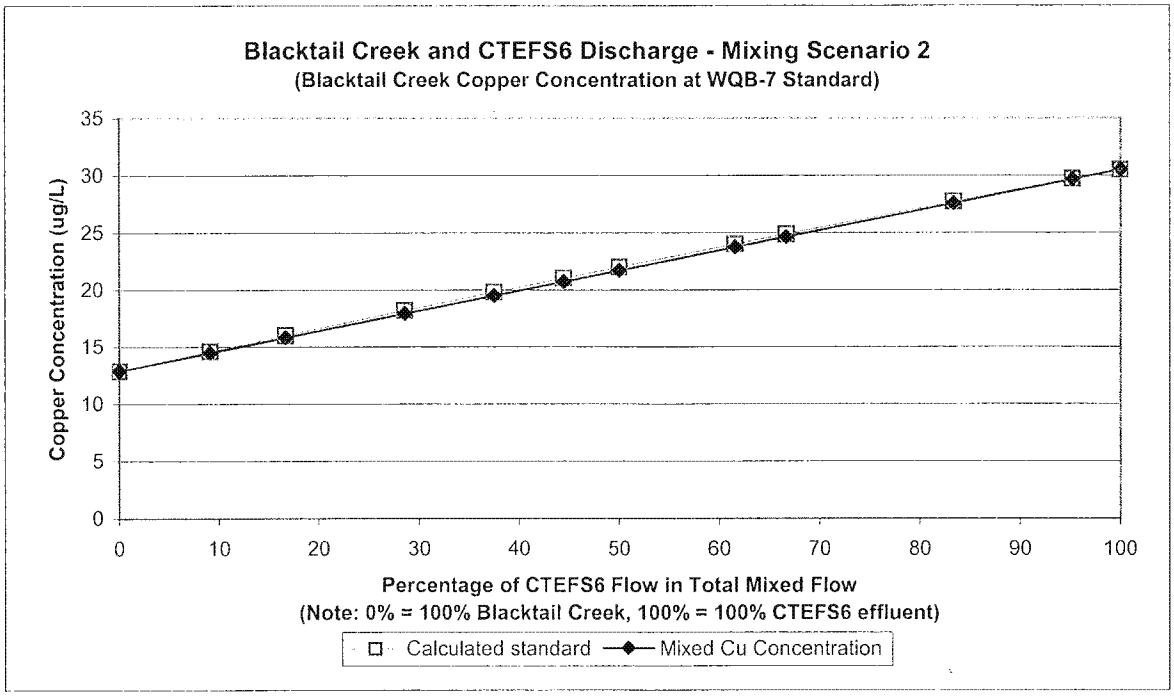
No other inputs (remove MSD, MPTP, STP etc.)

Parameters:

Blacktail: Cu = 12.89 ug/L, hardness = 146 mg/L, Cu standard = 12.89 ug/L

CTEFS6: Flow varies, Cu = 30.5 ug/L, hardness = 400 mg/L, standard = 30.5 ug/L

Blacktail flow (cfs)	CTEFS6 flow (cfs)	CTEFS6 % of total flow	Combined Cu (ug/L)	Combined Hardness (mg/L)	Calculated Cu Standard (ug/L)
5	0	0	12.89	146	12.89
5	0.5	9.1	14.49	169.09	14.61
5	1	16.7	15.83	188.33	16.02
5	2	28.6	17.92	218.6	18.2
5	3	37.5	19.49	241.25	19.8
5	4	44.4	20.72	258.9	21.03
5	5	50.0	21.7	219.9	22.01
5	8	61.5	23.73	302.3	24.01
5	10	66.7	24.63	315.33	24.89
2	10	83.3	27.57	357.67	27.72
0.5	10	95.2	29.66	387.9	29.71
0	10	100	30.5	400	30.5



Blacktail Creek concentrations averaged from Draft Lower Area One Expedited Response Action Final Phase II Monitoring Report For May 1998 Through June 30, 2000 (ESA Consultants, September 2000).

SBC mixing2 Scen 2